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OBSERVATIONS ON ATHENIAN WOMEN¹

For an account of the position of Athenian women in the fifth and the fourth centuries B. C. there is a great mass of evidence². Inferences may be drawn from Plato³ and Aristophanes⁴, from the kinds of women represented in sculpture and vase-painting and especially in the drama⁵, whom contemporary audiences found intelligible and interesting, and from inscriptions⁶. But there are three literary monuments which are so specific that they are particularly tempting to the historian, and they have formed, I believe, the basis of much that has been written on the position of women in Greek civilization.

The fullest of these three passages is in the *Oeconomicus* of Xenophon⁷. In this treatise Socrates is represented as reporting the remarks of one Ischomachus on the proper management of a household. Ischomachus is a very systematic person. He tells how he had set about educating his wife, who had come to him when she was not yet fifteen years old. We are not to feel that her youth or her need of training was exceptional; on the contrary, we are given to understand (7.11) that she was a desirable match. But training she did need, for the accomplishments she brought from home were only to spin, weave, and be discreet (7.6.14). She had been brought up to see as little as possible, to hear as little as possible, to ask as little as possible (7.5.1). Even though her position is now one of great responsibility and she is a mature woman, she is expected to spend her time in the house: 'It is better for a woman to stay at home than to gad about' (7.30). Among other prescriptions Ischomachus suggests that his wife mix flour, knead dough, shake and fold cloaks and bedclothes. These activities he recommends as good exercises, which will keep his wife healthy and her cheeks rosy (10.11).

¹This paper was read at the Twenty-eighth Annual Meeting of The Classical Association of the Atlantic States, held at Lafayette College, Easton, Pennsylvania, April 26-27, 1935.

²The types of testimony and their character are suggested by A. W. Gomme, *The Position of Women in Athens*, *Classical Philology* 20 (1925), 1-25. A convenient monograph (a dissertation), which uses much of the ancient evidence, is Jeannette J. B. Mulder, *Quaestiones Nonnullae ad Atheniensium Matrimonia Vitamque Coniugalem Pertinentes* (Trajecti ad Rhenum, L. E. Bosch et Filii, 1920).

³A convenient treatise on the subject is Jean Ithurriague, *Les Idées de Platon sur la Condition de la Femme au Regard des Traditions Antiques* (Paris, J. Gamber, 1931).

⁴Compare Herman W. Haley, *The Social and Domestic Position of Women in Aristophanes*, *Harvard Studies in Classical Philology* 1 (1890), 159-186.

⁵Compare Annemarie Jenzer, *Wandlungen in der Auffassung der Frau im Ionischen Epos und in der Attischen Tragödie*. This is a Bern dissertation (Zurich, 1933).

⁶Compare Helen McClees, *A Study of Women in Attic Inscriptions*. This is a Columbia University dissertation (New York, Columbia University Press, 1920).

⁷For an interesting paper on this treatise see L. R. Shero, *Xenophon's Portrait of a Young Wife*, *THE CLASSICAL WEEKLY* 26 (1932), 17-21.

The second of the explicit passages is the first oration of Lysias, entitled 'On the Murder of Eratosthenes'. This is a speech which Euphiletus delivers to defend his murder of his wife's lover, whom he had taken *in flagranti crimine*. The speech is not usually read in classes and Lysias is so compact that I may be allowed to quote the relevant portion⁸:

When I, Athenians, decided to marry, and brought a wife into my house, for some time I was disposed neither to vex her nor to leave her too free to do just as she pleased; I kept a watch on her as far as possible, with such observation of her as was reasonable. But when a child was born to me, thenceforward I began to trust her, and placed all my affairs in her hands, presuming that we were now in perfect intimacy. It is true that in the early days, Athenians, she was the most excellent of wives; she was a clever, frugal housekeeper, and kept everything in the nicest order. But as soon as I lost my mother, her death became the cause of all my troubles. For it was in attending her funeral that my wife was seen by this man, who in time corrupted her. He looked out for the servant-girl who went to market, and so paid addresses to her mistress by which he wrought her ruin. Now in the first place I must tell you, sirs (for I am obliged to give you these particulars), my dwelling is on two floors, the upper being equal in space to the lower, with the women's quarters above and the men's below. When the child was born to us, its mother suckled it; and in order that, each time that it had to be washed, she might avoid the risk of descending by the stairs, I used to live above, and the women below. By this time it had become such an habitual thing that my wife would often leave me and go down to sleep with the child, so as to be able to give it the breast and stop its crying. Things went on in this way for a long time, and I never suspected, but was simple-minded enough to suppose that my own was the chastest wife in the city. Time went on, sirs; I came home unexpectedly from the country, and after dinner the child started crying in a peevish way, as the servant-girl was annoying it on purpose to make it so behave; for the man was in the house,—I learnt it all later. So I bade my wife go and give the child her breast, to stop its howling. At first she refused, as though delighted to see me home again after so long; but when I began to be angry and bade her go,—"Yes, so that you," she said, "may have a try here at the little maid. Once before, too, when you were drunk, you pulled her about." At that I laughed, while she got up, went out of the room, and closed the door, feigning to make fun, and she took the key away with her. . . .

The remainder of the speech is not so pertinent. Euphiletus is eventually informed of his wife's infidelity by an old woman sent by one of Eratosthenes's earlier paramours who had grown jealous, and Eratosthenes is trapped and killed.

The names of Thucydides and Pericles combine to make the third of my passages very impressive. At

⁸1.6-13, in the translation by W. R. Lamb, in *The Loeb Classical Library*.

the end of Pericles's Funeral Oration Thucydides gives us this paragraph⁹:

If I am to speak also of womanly virtues, referring to those of you who will henceforth be in widowhood, I will sum up all in a brief admonition: Great is your glory if you fall not below the standard which nature has set for your sex, and great also is hers of whom there is least talk among men whether in praise or in blame.

The position of women indicated in these passages is the one familiar to us from our histories, handbooks on Greek life¹⁰, and commentaries on Greek authors. Writers on Greek subjects of course employ the other types of evidence I have mentioned. But their attitude seems to be fixed by these three passages, and other evidence is used chiefly to corroborate that attitude. I shall cite as an instance a paragraph from a generally sound book by W. H. S. Jones¹¹:

The blot upon the pictures of married life which have come down to us from the great period of Greek literature is the imperfect education and secluded life of the women. . . . This cramped life resulted in ignorance and lack of self-control. The Athenian lady's virtue was a "cloistered virtue." Hence no doubt the frequency at Athens of adultery on the part of the wife, and the loose morality of the husband outside the family circle. The physique of the race, as well as the morality (in the widest sense) of the women, must have suffered from the exclusion from open-air life and physical exercise. How much of this the Athenian woman enjoyed may be gauged from the recommendation of Ischomachus to his wife to attend to the clothes and coverlets in order to benefit her health.

I find the reference to "the frequency at Athens of adultery on the part of the wife. . . ." puzzling. Aside from jokes in Aristophanes and a law of Solon¹² I know of no evidence to support such an assertion—and are not jokes and laws on women's morality so common as to make their value as evidence questionable? And how fair is it to use a trial-court speech in a case of adultery and murder as evidence of a people's general conduct? I have often squirmed at the thought that future historians might be using the files of New York tabloid newspapers as a basis for describing the civilization in which I live. In any case all that we learn from the speech of Lysias is that in certain families a newly married wife was kept rather carefully and that she did not go abroad except accompanied by a servant.

Ischomachus's wife, we feel sure, would never be involved in a scandal, and so the evidence of the restraints put upon her ought to be more weighty. But Xenophon's whole treatise is, I think, tendentious, and so of less value than Lysias's speech. The question of women's rights had been much agitated at the end of the fifth century¹³. Herodotus, Euripides, and Aristophanes all reflect this interest, and the fifth book of Plato's Republic takes a pronounced feminist position.

⁹Thucydides 2.45.2, in the translation by Charles Forster Smith, in The Loeb Classical Library.

¹⁰There are, of course, exceptions. A very sound treatment, from which I have received much help, is F. R. Earp, *The Way of the Greeks*, 51-59 (Oxford University Press, London, Humphrey Milford, 1929). <For a review, by Professor Gertrude Hirst, of this book see THE CLASSICAL WEEKLY 26.31. C. K.>.

¹¹Greek Morality in Relation to Institutions, 87-88 (London, Blackie and Son, 1906).

¹²The law is cited, e. g. in Aeschines, In Timarchum 183. But what civilized people has not laws against adultery?

¹³Compare my remarks in a paper entitled Utopian Sources in Herodotus, *Classical Philology* 30 (1935), 113-121.

Now much of Xenophon's writing is in the nature of deliberate refutation or correction of Plato's teachings¹⁴. Aulus Gellius repeats a tradition that the Cyropedia is a counterblast to Plato's Republic¹⁵, and the so-called Socratic dialogues of Xenophon are clearly meant to correct Plato. To us the thought that Xenophon should deliberately and seriously set himself in opposition to Plato seems absurd—it is impudent enough for him to have undertaken a continuation of Thucydides! But Xenophon himself need not have thought so. So the Oeconomicus is meant to show the ideal conduct of a Greek wife, and errs as much toward the right as Plato had erred toward the left. As Gomperz (whose view of Xenophon is the one I have indicated above) said long ago¹⁶: "Xenophon was well aware that his own way of thinking was not that of his times".

There remains the Funeral Oration passage, which is difficult to explain away. We can only remark that the passage is something of a paradox. *Fame* is ascribed to a woman who is not talked about. Yet it was known everywhere that the man who enunciated this ideal was himself devoted to the most talked-about woman in Athens¹⁷. But taken at face value the passage shows merely that it was an ideal for ladies not to get themselves talked about. Is that not still an ideal among a solid part of our own people? Is it not still true also that unattended ladies may not go to certain places at certain times and to certain places at any time?

If, then, we disregard the passages in Xenophon and Lysias and suspend judgment in the case of the passage in Thucydides, we shall be better able to arrive at a fair estimate of the position of women in Athens. Accuracy in such matters is perhaps more important now than it was in earlier generations. Literate people are still anxious to get what lessons ancient Greece has to offer¹⁸, but they are preoccupied with so many interests that they are impatient of any but categorical statements suitable for use as labels to characterize a people or a period. But statements to be used as labels are open to two faults. They are apt to stress slight differences while they ignore general likenesses, and they are apt to express only a part or an aspect of the truth without qualification by necessary limitations. The Greeks are written down as sceptical and realistic, the men of the middle ages as credulous, the moderns as rational. These generalizations are partially true, but so partially that they are hardly worth making. It is not hard to show Greeks superstitious and romantic, medieval men with questioning minds, moderns credulous. Differences are in emphasis or in tendency, and are worth pointing out only if one remembers how slight they sometimes are. The commonplace found in many books to the effect that Athenian women were

¹⁴A good key to the copious literature on this subject is J. Geffcken, *Griechische Literaturgeschichte* 2.10, note 38 (page 7 of notes) (Heidelberg, 1934).

¹⁵Noctes Atticae 14.3.3-4.

¹⁶Theodor Gomperz, *Greek Thinkers*, Translated by G. G. Berry, 2.127 (London, Murray, and New York, Scribner, 1905).

¹⁷Mr. Gomme (see note 2, above), 13, makes this point.

¹⁸I have seen the following popular books dealing with Greek women, published since 1920: Theodor Birt, *Frauen der Antike* (Leipzig, Quelle und Meyer, 1932); Franz Burger, *Die Griechischen Frauen*, *Tusculum Schriften* 2 (Munich, Ernest Heimeran, 1926); F. A. Wright, *Feminism in Greek Literature* (London, Routledge, 1923); K. Kuiper, *De Atheensche Vrouw* (Haarlem, H. D. Tjeenk Willink en Zoon, 1920).

kept in Oriental seclusion and that all opportunities for self-development were denied to them is a generalization of this sort. It is really no longer necessary to demonstrate the injustice of this generalization. That has been done by several scholars, notably by Mr. A. W. Gomme in an article entitled *The Position of Women in Athens*, which appeared some ten years ago¹⁹. An interesting sentence which embodies one part of Mr. Gomme's argument may be quoted in this connection²⁰: "... There is, in fact, no literature, no art of any country, in which women are more prominent, more important, more carefully studied and with more interest, than in the tragedy, sculpture, and painting of fifth-century Athens". But it takes a long while for new points of view to become established, a long time for established views to die. That is my justification for these remarks.

Consider the enormous amount of nonsense which has been written about the hetairai at Athens²¹. Every literate person thinks he knows that all the great Athenians resorted to women of this class for intellectual companionship because their own wives were dull and stupid. That some hetairai were clever there is no doubt, but it is plain that as a class these women relied on their physical charms for attraction and it was therefore not for intellectual stimulation that men went to them²². The interesting thing in this connection is this: Despite the fact that Christianity had not yet impressed upon mankind a consciousness of sin in matters of sexual irregularity, there were already Aeschylus, Euripides, Plato to question the double standard in sexual conduct²³.

In rural America before the radio men would foregather about the stove in the general store and discuss politics and ethics and sports and whatever else may be discussed. The women held absolute sway in the house, spoke of "my parlor" as well as of "my kitchen", and controlled the domestic economy. I conceive the Greek arrangement to have been very much the same, even to the tendency toward social democracy and intellectual aristocracy which such an arrangement promotes. When ladies (and therefore the possibility of matrimonial complications) were present, there could be no easy intercourse between classes separated by wealth or formal education. But in the general store a man's breadth of information and acuity of perception counted. Those who know the Arabs, who, of course, keep their women secluded, remark on the true democracy among Arab men of varying social classes, and of Arab women also among themselves. Questions of social precedence are of no consequence unless women are involved. Socrates cannot have foregathered with his assorted interlocutors and enjoyed his freedom of discussion unless his meetings were 'stag'.

Lovers of Erasmus may recall that the same point is made in the delightful colloquy entitled *Convivium Re-*

ligiosum. The intellectual part of the *Convivium*, which had been as stimulating and as satisfying as the food and the drink, would not have been possible if wives had been present. When the guests inquire after the host's wife, he replies²⁴: 'But she's more at liberty among the women; and so are we too by ourselves'. That Erasmus was no more an obscurantist on the question of feminism than was Euripides is abundantly shown by the colloquy *Abbatis et Eruditae*, where a stupid abbot is derided for criticizing a lady because she owned and read too many and too serious books.

The so-called 'Oriental seclusion' of women practised at Athens is termed by writers on Greek life a decline from Homeric customs, which were still current in the fifth century in Sparta²⁵. One may ask incidentally, Why is it that Euripides, who certainly leans toward feminism and who certainly does not follow convention for its own sake, criticizes so severely the loose conduct of the Spartan girls?²⁶ Professor T. G. Tucker, in his *Life in Ancient Athens*, has written (again the sources mentioned at the beginning of this paper are recognizable)²⁷:

... It is a great blot on Athenian civilisation that the position of woman had retrograded since the days of Homer. Her business now is simply to be the housewife and housemother, to apportion to the slaves their domestic work, to regulate the stores, to weave and superintend the weaving of garments, and to bring up the girls and little boys. She has received no particular education beyond these domestic accomplishments. Her place is inside the house. She may go abroad at festivals or on other recognised occasions, if properly attended, but the best woman, according to the Athenian definition, is she of whom "least is said for either good or harm".

The difference between Homeric and Athenian society can easily be explained by the differences between city and country people which still prevail in polygamous societies. Nausicaa, Penelope, Arete, Andromache are cited, and correctly, to demonstrate Homer's fine understanding and respect for women. But we are seldom reminded how Telemachus put Penelope in her place²⁸:

'... Howbeit go to thy chamber and mind thine own housewiferies, the loom and the distaff, and bid thy handmaids ply their tasks. But speech shall be for men, for all, but for me in chief; for mine is the lordship in the house'.

And Hector says to Andromache²⁹:

'... But go thou to thine house and see to thine own tasks, the loom and the distaff, and bid thine handmaids ply their work; but for war shall men provide, and I in chief of all men that dwell in Ilios'.

If these words were found in Attic tragedy, they would, I think, be used as an additional proof of the constraint put upon women³⁰.

¹⁹See note 2, above. ²⁰Page 4.
²¹A particularly objectionable book, because of its scientific pretensions, is Hans Licht, *Sexual Life in Ancient Greece*, Translated by J. H. Freese (London, Routledge, 1932).

²²Mr. Earp, 56 (see note 10, above) makes this point.
²³That is the implication, I think, of Agamemnon 850-851, Medea 245-248, and Republic 5.451 A-451 B. For Euripides on women see Antonio Giusti, *Euripide e le Donne*, *Il Mondo Classico* 5 (1935), 111-118.

²⁴Translations of the two colloquies here mentioned are easily accessible in the *Abbey Classics: Twenty Select Colloquies of Erasmus Translated by Sir Roger L'Estrange* (1680), With an Introduction by Charles Whibley (London, Chapman and Dodd). The sentence quoted is on page 85 of this book.

²⁵For Spartan women see J. H. Thiel, *De Peminarum Apud Doros Condicione*, *Mnemosyne* 57 (1920), 193-205.

²⁶I have in mind particularly *Andromacha* 595-600.

²⁷81-82 (London, Macmillan, 1906).

²⁸*Odyssey* 1.356-359, repeated at 21.344-347.

²⁹*Iliad* 6.490-493.

³⁰Passages from tragedy frequently cited to prove the inferior position of women include Aeschylus, *Septem* 232; Sophocles, *Ajax* 293; Euripides, *Heracleidae* 476.

I find critical horror of Greek illiberalism in the attitude toward women particularly amusing in view of the boundless admiration for free, pagan womanhood expressed by the Hellenists of the early nineteenth century, by Wieland and Goethe in Germany, and by Byron and others of their followers in England. The point of view is illustrated by these lines from Don Juan³¹:

And thus they form a group that's quite antique,
Half naked, loving, natural, and Greek.

But it is easy to show that Greek tragic heroines outdid even the Victorians in reticence and prudery. I cite two instances from Euripides. When Phaedra's nurse is concerned over her mistress's health, she says³²: 'If your disease is some unmentionable malady, these women are here to help your ailment. But if your trouble can be told to males, speak out, so that the matter may be recounted to the physicians'. When Iphigenia grows curious over Clytemnestra's fate, Orestes reproves her thus³³: 'Let mother's story be; it is not nice for you to hear'. Iphigenia answers, *αἰγῶ*, 'I am dumb'. Probably the best proof of Athenian prudery is the wistful description of the old-fashioned education of boys put by Aristophanes into the mouth of the Just Logic³⁴. Rules of conduct could not be more exacting in the strictest young ladies' seminary.

We may no more say, then, that Athenian women were all 'pagans' or all pruders than we may say that all French women are coquettes or that all German women are interested only in their three K's. On the whole, I think, the attitude toward women among the Athenians was much the same as among ourselves, with much the same variations³⁵. My own observation in reading literatures foreign to the western tradition is that the women seem much more familiar than the men. In order to understand why men in the Arabian Nights or in Indian poetry behave as they do an effort of the imagination is required of the western reader. But the women are immediately intelligible. Kalidasa and her friends in Shakuntala's drama, Sita in the Ramayana, the women in the Arabian Nights speak to us directly and teach us about life. If it were not so, if the relations between men and women were on an essentially different plane in Indian literature and in Greek literature than they are among us, these literatures would be useless to us except to satisfy an antiquarian curiosity. It is precisely because the Greeks were so like ourselves, even in the range of social practices and attitudes, that their literature is for us something more than an exercise ground for linguistics or source material for economists. If we wish to derive these subtler lessons from our Greek literature, we can derive them only by reading the literature; we can

not rightly derive them from the distillations of an intervening interpreter.

COLUMBIA UNIVERSITY

MOSES HADAS

RECOVERY OF VEGETATION IN THE ASH ERUPTED BY VESUVIUS IN 79¹

The reason why Pompeii was never rebuilt after the eruption of Vesuvius in 79, and the agricultural district surrounding the site of the city did not for many years regain its former importance is a matter of some discussion². Before 79 the city of Pompeii and the agricultural region surrounding the city were rich and prosperous³. Yet, after the eruption, this district was allowed to languish, and never again during the Roman Empire did this territory regain its former position⁴. The fact that a deep layer of volcanic ash covered the country after the eruption of Vesuvius in 79 has usually been set forth as sufficient reason for the long retarded recovery of this area⁵.

The territory which was covered by volcanic ejecta^{6a} in 79 reached from Vesuvius on the north to the Apennines on the east, to Stabiae and Surrentum on the south, and to the sea on the west⁶. In 1879, Signor Ruggiero investigated the depth of the ejecta which

¹I am indebted to Professor Charles Knapp for many helpful suggestions in the preparation of this paper. My husband, Dr. John Day, of Barnard College, has checked and interpreted all classical references. Three articles by Professor Robert Fiske Griggs will be frequently cited in these notes. They appeared in the *Ohio Journal of Science* 19 (1918-1919), under the general heading, *Scientific Results of the Katmai Expeditions of the National Geographic Society*. References to these articles will be made as follows: Griggs, Kodiak = The Recovery of Vegetation at Kodiak, 1-57; Griggs, Effects on Nearby Vegetation = The Character of the Eruption as Indicated by its Effects on Nearby Vegetation, 173-209; Griggs, Katmai Valley = The Beginning of Revegetation in Katmai Valley, 318-342.

²The question of the rebuilding of Pompeii Professor Michael I. Rostovtzev (= Rostovtzeff) has discussed in his book, *Storia Economica e Sociale dell' Impero Romano*, 232 (Firenze, "La Nuova Italia": no date of publication is given), and in his book, *Out of the Past of Greece and Rome*, 52 (New Haven, Yale University Press, 1932). Professor Tenney Frank also discussed this question in his book, *An Economic History of Rome*, 414 (Baltimore, The Johns Hopkins Press, 1927).

³Rostovtzev <= Rostovtzeff>, *Storia Economica* . . . , 33, 70, note 21, 71, 76, and 111, note 19 (see note 2, above); Frank, *An Economic History of Rome*, 245-267 (see note 2, above); R. C. Carrington, *Studies in the Campanian 'Villa Rusticae'*, *The Journal of Roman Studies* 21 (1931), 110-130; John Day, *Agriculture in the Life of Pompeii*, *Yale Classical Studies* 3 (1932), 167-208. <For a notice of Dr. Day's article see THE CLASSICAL WEEKLY 26.165-166. The notice occurs in a review, by Dr. Moses Hadas, of *Yale Classical Studies*, Volume Three. C. K.>

⁴Johannes Overbeck, *Pompeii in Seinen Gebäuden, Alterthümern, und Kunstwerken*, Vierte Auflage, im Vereine mit August Mau, 25 (Leipzig, Wilhelm Engelmann, 1884).

⁵Frank, *An Economic History of Rome*, 414 (see note 2, above).

^{6a}<ames> Logan Lobley, *Mount Vesuvius*, 221-238 (London, Roper and Drowley, 1889) gives definitions of various kinds of volcanic ejecta.

Ash is fine black dust or sand.

Lapilli are small volcanic ejecta, usually pumiceous. They are smaller than volcanic cinders, although not so fine as ash. Professor Lobley states that the lapilli on the streets of Pompeii furnish a good example of this form of volcanic ejecta. They vary in size from that of a pea to that of a small orange.

Cinders are scoriaceous fragmentary lava of irregular form and size. They are intermediate in size between lapilli and bombs.

Bombs are rounded masses of solidified lava. They are usually six to twelve inches in diameter.

Lava is the name used for both the fluid fused rock emitted by a volcano and the solidified stony masses that result from the cooling of this fluid rock.

Pumice is a highly porous and consequently very light volcanic material. It floats on water because its specific gravity is so low.

⁶Michele Ruggiero, *Pompei e la Regione Sotterrata dal Vesuvio nell' Anno LXXIX*, in *Discorso Pronunziato in Pompei addì 25 di Settembre 1879 nella Solennità del Diciottesimo Centenario dopo la sua Distruzione*, especially 23 (Naples, Francesco Giannini, 1879. Pp. 32, Plates VI).

³¹Canto 2.194. ³²Euripides, *Hippolytus* 293-296.

³³Euripides, *Iphigenia Taurica* 927-928.

³⁴Aristophanes, *Nubes* 961-983.

³⁵Of the types of evidence presented in my first paragraph the least 'tendencious' is epigraphy. It is interesting to read in Miss McClees's book (see note 6, above), 2: "The inscriptions, on the other hand, show that in practice there was much to render the lot of Athenian women comparatively happy and normal". Miss McClees goes on to speak of the appreciation of women expressed in epitaphs and in sepulchral reliefs, and of the fact that women were able to make considerable gifts to individuals and institutions.

covered the region about Pompeii. He did this by means of several trenches which he dug outside the walls of Pompeii. Trench 1, which was close to the walls of the city and not far from the wall of the amphitheater, disclosed that the first form of volcanic ejecta that fell on Pompeii in 79 was white lapilli⁷. This layer of lapilli was of a depth of 2.73 meters. Over it was a layer of ash interspersed with two strata of gravel of a depth of 1.63 meters. Lastly, there was a layer of vegetable earth of 1.50 meters⁸. The depth of this trench, exclusive of the top layer of vegetable earth, was 4.36 meters. There is likelihood, however, that the upper part of the ash bed was slowly converted into vegetable matter so that the above figures do not give the full depth of the volcanic ejecta deposited in 79. Signor Ruggiero dug thirteen other ditches at varying distances from the walls of Pompeii⁹. Only two of these ditches (they too were close to the walls of the city) disclosed the white lapilli which were characteristic of the eruption of 79¹⁰. The depth of the deepest ditch of the remaining eleven totaled 2.36 meters (this included the top layer of vegetable earth); exclusive of the top layer of vegetable earth the depth of the ditch totaled 1.56 meters¹¹. These facts would indicate that there had been some washing away of the ash in the immediate neighborhood of Pompeii. However, one villa excavated in the region of Boscoreale was buried under the present level of the ground to a depth of 5.40 meters, of which a little more than four meters consisted of ejecta erupted in 79¹². Another villa excavated in the region of Boscoreale was buried under the present level of the ground to a depth of about eight meters¹³. Consequently, no definite conclusions can be drawn concerning the washing away of the ash deposit made in 79.

Sir Henry James Johnston-Lavis estimated the volcanic ejecta which fell inside the city of Pompeii in 79 to be four meters in depth¹⁴. He classified the lowest stratum as white light pumice, the middle stratum as brownish or greenish gray pumice, and the top stratum as a fine brownish or grayish ash bed, rich in pisolites, and broken by two thin bands of lapilli¹⁵.

Since the figures given above indicate the depth in modern times of the volcanic ejecta of 79, they can be relied upon only as indicating the *minimum* depth of the volcanic deposit at the time of the eruption. All the ejecta must have packed down; some of them may have been washed away. The depth of the ejecta which covered the area devastated in 79 has been variously estimated as from ten to forty feet¹⁶. It is generally believed that the *tops* of the buildings at Pompeii were not covered^{16a}. There are evidences of tunneling down to some dwellings and tunneling through the walls

from one dwelling to another¹⁷. This tunneling also explains the fact that in most houses few articles of household furniture of value have been found¹⁸. Whether the tunneling was done by the survivors after the eruption or by vandals at a later period cannot be definitely proved. The fact that tunneling was necessary indicates that the houses must have been covered to a considerable depth.

The ash is believed to have been deposited in a moist condition, because molds made by the bodies of those who lost their lives in 79 are so perfect as to suggest immediate encasement¹⁹. Also, the presence of pisolites indicates that the fall of ash must have been accompanied by showers; the formation of similar pisolites was caused by showers during the eruption of Vesuvius in 1906²⁰.

Our knowledge of the region about Pompeii after the eruption of 79 is extremely meager. We learn from Dio Cassius²¹ that the Emperor Titus made an attempt to restore the region immediately after the eruption, but the fire in Rome, the Emperor's death in 81, or the extent of the destruction in Campania seems to have ended all plans of rehabilitation. Only two contemporary writers refer to the condition of this territory between 79 and 150, namely, the poets Martial²² and Statius²³. Each emphasizes the bareness of the region. Dio Cassius is the first literary source to give any definite information in regard to the recovery of the area. In Book 66, written in the first half of the third century, he describes Vesuvius of his own day. At that time the outlying heights of Vesuvius supported vines and trees in abundance²⁴.

Our knowledge of the towns in this vicinity after 79 is also extremely meager. Nuceria, a town on the Sarno, for which Pompeii had served as a port²⁵, is not mentioned again during the Empire²⁶. That town, however, was rebuilt at some later time, for at present a town named Nocera stands close to the ancient site²⁷. Stabiae was rebuilt during the time of the Empire, for a settlement is known to have existed there one hundred years after the eruption of 79. This settlement, however, was not built over the ruins of the old town, but somewhat southwest from the former site²⁸. Nola, another town for which Pompeii had served as a port²⁹, is the only town in this region which showed signs of prosperity after the eruption. Nerva (96-98) strengthened a colony which had been established there by Vespasian³⁰; in the later days of the Empire it was an important town³¹. Nola, however, is situated near the edge of the region which was covered by ash in 79.

¹⁷*Ibidem*. ¹⁸*Ibidem*.

¹⁹Sir H. Johnston-Lavis, *The Eruption of Vesuvius in April, 1906*, The Scientific Transactions of the Royal Dublin Society, Series II, Volume 9 (1905-1909), 130-200, especially 175.

²⁰Sir H. Johnston-Lavis, *The Eruption of Vesuvius in April, 1906*, The Scientific Transactions of the Royal Dublin Society, Series II, Volume 9 (1905-1909), 130-200, especially 175.

²¹Dio Cassius 66.24.3-4. ²²Martial 4.44.

²³Statius, *Silvae* 4.4.78-86. ²⁴Dio Cassius 66.21.1-4, especially 3.

²⁵Strabo 5.4.8. ²⁶Julius Beloch, *Campanien, Geschichte und Topographie des Antiken Neapel und Seiner Umgebung*, 243 (Breslau, E. Morgenstern, 1890).

²⁷*Ibidem*, 246. ²⁸*Ibidem*, 249. ²⁹Strabo 5.4.8.

³⁰Beloch, *Campanien*, . . . , 392 (see note 26, above).

³¹*Ibidem*, 392.

⁷*Ibidem*, 12, Plates I, II. ⁸*Ibidem*, Plate II.

⁹*Ibidem*, Plate I. ¹⁰*Ibidem*, Plates I, II.

¹¹*Ibidem*, Plate II. ¹²Notizie degli Scavi di Antichità 1903, 64.

¹³Notizie degli Scavi di Antichità 1876, 196.

¹⁴Sir H. Johnston-Lavis, *The Geology of Monte Somma and Vesuvius*, The Quarterly Journal of the Geological Society of London 40 (1884), 35-119, especially 83.

¹⁵*Ibidem*, 83-85.

¹⁶August Mau, *Pompeii, Its Life and Art*, 20 (Translated by Francis W. Kelsey, New York, Macmillan, 1902); Herbert F. De Cou, *Antiquities from Boscoreale*, in Field Museum of Natural History, Anthropological Series 7, Publication 152, Field Museum of Natural History, Chicago (1912), 150.

^{16a}Mau, *Pompeii*, . . . , 25 (see note 16, above).

Since the region about Pompeii had derived its prosperity from its agricultural activities, obviously a study of the region as it existed after 79 must consider the effect of volcanic ash on vegetation. Two considerations are of importance: first, can volcanic ash alone support vegetation, and, secondly, if it can, how soon can it do so? After we consider these points, we must study Vesuvian ash to determine what probable effect the ash of 79 had on vegetation. Finally, we must consider the economic condition of the Empire at that time to determine what effect it may have had on the agricultural development of the ash-covered area.

Many studies and observations of volcanic ash have been made. It has been found that, when the ash covering is light, many plants may lie dormant for two or three years and then send up new shoots through the ash, with the result that the area is soon covered with vegetation³². It has been noted, however, that plants as a rule are not able to send out new shoots through an ash covering deeper than three feet³³. It has also been found that a mixture of soil and ash will produce crops³⁴. However, since the ash which was erupted at Pompeii in 79 covered the area to a depth of at least twelve feet, there is little likelihood that old plants would have sent up new shoots through the ash, nor is it likely that the inhabitants would have been able to mix the soil and the ash over an appreciable area of the devastated region. Consequently, we shall consider chiefly those studies of areas destroyed by volcanic ejecta in which the problem of revegetation by means of seedlings has been taken up.

³²Griggs, Kodiak, 32-35 (see note 1, above).

³³Griggs, Effects on Nearby Vegetation, 189.

³⁴W. N. Sands, An Account of the Return of Vegetation and the Revival of Agriculture, in the Area Devastated by the Soufrière of St. Vincent in 1902-3, West Indian Bulletin 12 (1912), 22-31, especially 29.

Expeditions sent out by the National Geographic Society, under the directorship of Professor Robert Fiske Griggs, made a study of revegetation in the areas covered by ash which was thrown out by Mt. Katmai when it was in eruption in June, 1912. Mr. Katmai is in Alaska. A chemical analysis of this ash, given in Table I³⁵, shows that this ash contained all the mineral elements in soil that are necessary for plant life, with the exception of nitrogen³⁶. Since nitrogen has, as its ultimate source, the atmosphere rather than the earth, it is not found in volcanic ash³⁷. The chemical analyses of the water soluble salts contained in the ash of Mt. Katmai show that it contained only 0.05% of water soluble potash, which is the minimum concentration necessary for plant growth, and but a trace of phosphoric acid³⁸. Because of the low amount of salts necessary for plant growth, and the high content of SiO₂ (silica), Professor Griggs did not consider this ash fertile, and, in fact, characterized it as practically pulverized granite³⁹. The depth of this ash varied. At Kodiak, an island, where many of the observations were made in regard to revegetation, the ash fall was but a foot in

³⁵I insert here Table I, to facilitate a comparison of the chemical analyses of the volcanic ejecta thrown out by the different volcanoes which I shall discuss in this paper. The analyses of the ejecta from Vesuvius in 1906 by Professor Casoria and the analysis of the ash of the Soufrière do not include the soluble salts. They are given in Table II and in note 70, below, respectively. The other analyses are of the various ejecta as a whole with no separation of soluble and insoluble elements.

³⁶Griggs, Kodiak, 16, note. This chemical analysis was made by Elton Fulmer, State Chemist of Washington, for the United States Department of Agriculture. R. W. Thatcher, Crops and the Soil, in Joseph S. Chamberlain, Chemistry in Agriculture, 1-17, especially 7-10 (New York, Chemical Foundation, Inc., 1926), lists in the following order the mineral elements in soil which are essential for plant growth: nitrogen, phosphorus, potash, calcium, magnesium, iron, and sulphur. The last three elements are needed in small quantities and are of about equal importance.

³⁷Thatcher, Crops and the Soil, 7 (see note 36, above).

³⁸Griggs, Katmai Valley, 332, note. These analyses were made by Professor C. W. Foulk.

³⁹Griggs, Kodiak, 16-17.

TABLE I <Part of note 35>

	Mt. Katmai Ash	Soufrière Ash	Soufrière Pumice	Mt. Pelé Sand	Mt. Pelé Pumice	Krakatau Ash	Krakatau Pumice	Vesuvius Lava—1906 (Lacroix)	Vesuvius Lava—1906 (Casoria)	Vesuvius Red Ash 1906 (Casoria)	Vesuvius Gray Ash 1906 (Casoria)	Vesuvius Lapilli—1906 (Casoria)	Vesuvius Lapilli—1906 (Lacroix)	Pompeii Lapilli (Lacroix)	Pompeii Pumice (Casoria)
SiO ₂	72.16	57.62	55.64	60.01	61.07	61.36	68.99	47.80	47.614	48.154	48.117	48.573	48.10	54.50	54.600
Al ₂ O ₃	13.85	19.76	18.21	17.54	17.55	17.77	16.07	18.46	18.671	18.437	19.082	16.614	15.31	21.70	22.706
Fe ₂ O ₃	2.85	3.43	3.63	2.88	2.13	4.39	2.63	1.32	3.511	7.505	7.709	4.677	3.20	0.80	2.610
MnO	0.41	3.90	4.83	4.30	4.13	1.71	1.10	7.75	5.854	2.750	2.772	5.365	5.45	1.98	
MgO	0.47	1.82	3.48	2.76	2.26	2.32	1.08	3.79	3.924	4.432	3.728	5.038	7.55	0.54	1.405
CaO	3.80	6.25	8.10	6.80	6.28	3.43	3.16	9.18	8.337	8.244	7.949	10.385	12.45	3.20	2.600
Na ₂ O	3.86	3.79	3.55	3.41	3.50	4.98	4.04	2.78	2.310	2.871	2.528	2.398	1.98	6.40	6.096
K ₂ O	2.43	0.71	0.58	0.89	0.98	2.51	1.83	7.15	7.099	5.834	6.403	5.230	4.22	9.14	9.664
P ₂ O ₅	0.36	0.17	0.11	0.15	0.15			0.25	0.802	0.743	0.852	0.795	0.12		0.047
TiO ₂	Trace	0.87	0.98	0.45	0.47	1.12	0.82	1.16	0.767	Indeter- minate	Indeter- minate		1.15	0.27	
BaO															
SrO			0.03	0.03	0.02				0.177	0.095	0.093				
S										0.033	0.028				
SO ₃	0.20	0.11	0.04	Trace	0.016										
Cl															
H ₂ O		-0.41 +0.59	-0.20 +0.54	-0.10 +0.30	-0.23 +1.37			0.93					0.87	0.49 0.89	
ZnO					Faint Trace										
Li ₂ O				Faint Trace	Trace										
Fire Loss	0.65														

Explanations

Explanations of the symbols in column 1 are as follows (in parentheses are given the names more commonly used to designate certain substances):

SiO₂ = silicon dioxide (silica); Al₂O₃ = aluminum oxide (alumina); Fe₂O₃ = ferric oxide; FeO = ferrous oxide; MnO = manganous oxide (manganese); MgO = magnesium oxide (magnesia); CaO = calcium oxide (lime); Na₂O = sodium oxide (soda); K₂O = potassium oxide (potash); P₂O₅ = phosphorus pentoxide; TiO₂ = titanium dioxide; BaO = barium oxide; SrO = strontium oxide; S = sulphur; SO₃ = sulphuric acid; Cl = chlorine; H₂O = water; ZnO = zinc peroxide; Li₂O = lithium oxide.

depth⁴⁰. In Katmai Valley, on the mainland, where many other observations were made, the ash fall was much greater in depth⁴¹. However, the members of the expeditions were extremely careful to note, in all their observations, whether new growth came from seedlings in the ash, or from old roots sending out new shoots. For the first two years after the eruption of Mt. Katmai the region of Kodiak was bare and desolate, like a desert, but in 1915 vegetation from old roots made a marked change in the landscape⁴². In the latter part of that year, three years after the eruption, the expedition noted seedlings growing in the ash at Kodiak⁴³. In the same year, the investigators also noted seedlings growing in the deeper ash in Katmai Valley⁴⁴. In 1916, after a hard northern winter, which was so severe as to kill many small spruces, many of these seedlings survived⁴⁵. One of the seedlings that appeared, both at Kodiak and in Katmai Valley, was the lupine⁴⁶. In Katmai Valley this was the only plant to flourish in the most exposed places⁴⁷. Since the lupine can utilize the nitrogen from the air through nodules which form on its roots, it can thrive in a soil poor in nitrogen. In addition, these nodules, which remain in the ground, enrich the soil around the plant with nitrogen, that important element which is lacking in volcanic ash⁴⁸. Consequently this plant served as a pioneer in revegetation, particularly in Katmai Valley, where the ash fall was deeper than at Kodiak⁴⁹.

At Kodiak the first seedlings were noticed in sheltered places, such as the forest, where they were protected from the wind⁵⁰. In less sheltered areas, plants appeared in places which had been washed by the runoff from rains⁵¹. In Katmai Valley the new seedlings also showed a preference for wet places or places that gave evidence of water action⁵². Even the lupine would grow only in well drained situations in the valleys which had been covered by stream waters⁵³. Professor Griggs stated that the readiest explanation of the preference of these seedlings for wet places or places that had been washed by water was that the ash was too porous to hold sufficient moisture⁵⁴. However, he did not think that this reason applied in this case, since the rainfall in that section of Alaska is very constant⁵⁵. The rainfall averages approximately sixty inches during the year^{56a}. In addition, even more moisture is available for plant growth than is indicated by the precipitation figures, since mist is prevalent⁵⁶. Professor Griggs stated that, even after the drought of 1915, the ground was visibly moist beneath the surface⁵⁷. He offered two explanations for this preference of the seedlings in Alaska, (1) that the evaporation of the water caused a greater concentration of salts in wet places or places that had

been wet⁵⁸, (2) that the running water buried the seeds and thus gave them a chance to start⁵⁹. There is evidence that the seeds found difficulty in securing a root-hold in the loose ash which was so readily blown about by the wind⁶⁰. One bare field, where there were no birds, was divided by members of the expedition. Over one half of the field they scattered seeds; in the other half of the field they planted seeds in the ash. The seeds which were planted sprouted, but the other half of the field where the seeds were scattered remained bare⁶¹.

Spontaneous vegetation in Alaska was hampered not only by the high winds, but also by the long, though not usually severe, winter and consequent short growing season⁶². Vegetation may also have been hampered by a lack of sunlight, due to the prevalence of cloudy weather, but Professor Griggs thought that the long daylight hours in the summer compensated for the lack of sunlight⁶³.

In addition to the experiments and the observations which were made by the Katmai Expeditions of the National Geographic Society, the Government Experimental Farm at Kalsin Bay, in Alaska, conducted experiments with pasture grasses to determine the possibilities of revegetation in the volcanic ash of Mt. Katmai. In November, 1918, Professor Griggs summarized the results of these experiments as follows⁶⁴:

... At the Government Experimental farm at Kalsin Bay a number of pasture grasses were planted soon after the ash fell. The seeds came up well, giving an almost perfect stand in nearly every case. Where heavily manured, many of the plots have continued to do well, and some of them have formed a good turf on the ground.

Where planted in the untreated ash or with little fertilizer, different species have behaved differently. In some, most of the plants were overwhelmed while yet small, but a few individuals managed to get a good start and are now strong enough to hold their own against the undermining wind, while in others most of the original plants have persisted, but have made only very slight growth. On the timothy plot, for example, most of the plants are still living, but after four years are only three inches tall....

However, the volcanic ash of Mt. Katmai did not support vegetation in all places as quickly as in those cited in the foregoing instances. At Kodiak, in regions where the ash was so situated to be kept well drained, the particles of the ash set together so as to form a compact hard mass. Laboratory experiments were conducted with seedlings in this ash, but the results were very unsatisfactory⁶⁵. Professor Griggs thought that the difficulty was due to lack of aeration and to the mechanical obstacles that such ash offered to root extension. At that time, he doubted, because of the low fertility of the ash, that vegetation could ever start in such regions⁶⁶. But in 1930, eighteen years after the eruption, he found that one such region which the Mt.

⁴⁰*Ibidem*, 3.

⁴¹Griggs, Katmai Valley, 325. ⁴²Griggs, Kodiak, 3. 6.

⁴³*Ibidem*, 49. ⁴⁴Griggs, Katmai Valley, 325.

⁴⁵Griggs, Kodiak, 49-50. ⁴⁶Griggs, Katmai Valley, 325.

⁴⁷Griggs, Kodiak, 49; Griggs, Katmai Valley, 325.

⁴⁸Griggs, Katmai Valley, 325.

⁴⁹*Ibidem*, 325; Joseph Russell Smith, *Industrial and Commercial Geography*, 226-227 (New York, Henry Holt and Company, 1930).

⁵⁰Griggs, Katmai Valley, 325. ⁵¹Griggs, Kodiak, 49.

⁵²*Ibidem*, 51. ⁵³Griggs, Katmai Valley, 330.

⁵⁴*Ibidem*, 327, 330. ⁵⁵*Ibidem*, 330. ⁵⁶*Ibidem*.

^{56a}Griggs, Kodiak, 19. ⁵⁷*Ibidem*.

⁵⁸Griggs, Katmai Valley, 330.

⁵⁹*Ibidem*, 330-332.

⁶⁰Griggs, Kodiak, 51.

⁶¹Griggs, Kodiak, 37; Griggs, Katmai Valley, 338.

⁶²Griggs, Katmai Valley, 335-336. ⁶³Griggs, Kodiak, 18.

⁶⁴*Ibidem*, 19. ⁶⁵Griggs, Kodiak, 36-37. ⁶⁶*Ibidem*, 44.

⁶⁷*Ibidem*, 44-45.

Katmai expeditions had especially observed was heavily clothed with grass⁶⁷.

The investigations of the Mt. Katmai Expeditions are the most thorough and scientific that have been made from the point of view of plant growth in volcanic ash, but other studies have been made which give additional information. Some agricultural experiments and careful observations of revegetation in volcanic ash were made in connection with the ash erupted by the Soufrière of St. Vincent in the West Indies in 1902-1903. The ejecta of this particular eruption of the Soufrière varied considerably in depth. In some valleys the depth of the ejecta was fifty to eighty feet; on level ground the depth was from one to five feet; on steep slopes the depth was but a few inches⁶⁸. A comparison of a chemical analysis of this ash with a chemical analysis of the Mt. Katmai ash (see Table I, in note 35, above) indicates that this ash was less fertile than the Mt. Katmai ash, since it contained considerably less potash and phosphorus, although it was richer in calcium and contained less silica⁶⁹. Some water soluble elements were found in the analysis of this ash, but neither water soluble potash nor phosphoric acid was detected by the chemist⁷⁰.

The experiments referred to above were conducted by the British Imperial Department of Agriculture at a small experiment station which the Department started near Georgetown in January, 1903, for the purpose of determining whether this ash alone could support the usual crop plants of ground nuts, sugar cane, sweet potatoes, and arrowroot. It was found at that time, which was soon after the ash had fallen, that the ash alone (i. e. without fertilizer) would not support these crop plants⁷¹. This result parallels in a sense the experiments which were made in Alaska soon after the ash had fallen, experiments of which I have spoken⁷². In Alaska, in some cases the ash alone could support crop grasses, but to produce good results in the majority of cases the ash needed to be fertilized.

Observations of spontaneous vegetation in the ash of the Soufrière were made by Mr. W. N. Sands and Dr.

⁶⁷I give below a letter, dated April 23, 1932, which I received from Professor Griggs, in response to a letter which I had written to him. In my letter I inquired about the condition at that time of plant growth at such vegetation stations as No. 14, to which he referred on page 45 of his article on The Recovery of Vegetation at Kodiak (see note 1, above). This vegetation station had been established where the particles of ash had formed a compact hard mass; Professor Griggs had thought that vegetation would never start in such ash. His letter reads:

"The station about which you inquire was heavily clothed with grass (*Aira, Calamagrostis*.) in 1930. The willows had grown out over a good share of it so that the old wire reel shown in the picture to which you refer now lies far within the bushes.

In the few bare places the ground was covered with liverwort (*Jungermannia sphaerocarpa*, *Nardia scalaris* and a *Cephalozilla*). There is no tendency for the ash of Katmai to cement into a stone like mass, but it may become compact and poorly aerated."

⁶⁸W. N. Sands, An Account of the Return of Vegetation and the Revival of Agriculture, in the Area Devastated by the Soufrière of St. Vincent 1902-3, West Indian Bulletin 12 (1912), 22-31, especially 23.

⁶⁹J. S. Diller, Volcanic Rocks of Martinique and St. Vincent, The National Geographic Magazine 13 (1902), 285-296, especially 291. The analyses of the ash and the pumice erupted by the Soufrière of St. Vincent in 1902 were made by Mr. George Steiger.

⁷⁰*Ibidem*, 291. Mr. Steiger's analysis of the ash of Soufrière shows three substances to be soluble in water in the following amounts: SO₃ (sulphuric acid), 0.29, CaO (calcium oxide, or lime), 0.20, and Na₂O (sodium oxide or soda), 0.08. Mr. Steiger found no water soluble elements when he was analyzing the pumice of Soufrière.

⁷¹Sands, West Indian Bulletin 12 (1912), 29 (see note 68, above).

⁷²See the text immediately preceding the mark: for note 42, above.

Tempest Anderson. Mr. Sands, in his account of revegetation after the eruption of 1902-1903, writes the following⁷³:

From Richmond works, proceeding along the coast in the direction of the volcano, a plateau of ash is soon reached which was put down in the form of an incandescent avalanche. This avalanche destroyed Richmond village, and covered the northwest portion of the plantation lands to a depth of several feet. It is observed that the top layer of ash has formed a crust, but this has been broken up at frequent intervals by heavy rains; the result is that numerous shallow water-channels have been formed. It is observed that it is only in these depressions that plants have been able to get a root-hold. The chief plant lining the sides is the silver fern (*Gymnogramme calomelanos*, Kaulf.), which is playing the important part of preparing the ash for higher types. Already a few hardy plants such as the hurricane grass (*Arundinella martinicensis*, Trin.), *Emilia sonchifolia*, D. C., cattle-tongue (*Pluchea odorata*, Cass.), *Eupatorium odoratum*, L., and a sedge or two are found growing with the ferns. Here it is evident that these are the true ash plants, and have grown from spores and fruits brought by wind and water; but chiefly by the former. . . .

He continues⁷⁴:

Estate animals have lately been allowed to roam over the ash on their way to the higher lands at the back, and have broken up the crust between the channels to a considerable extent, so that there appears little doubt that this tract will soon be completely covered with herbaceous plants, shrubs and grasses.

He concludes by saying⁷⁵:

To-day, eight years after the last eruption, we see that the vegetation on the mountain slopes, and other places, has largely returned, and that agricultural conditions are almost normal.

Dr. Anderson, in his article on the same eruption, an article which was written in 1908 and which is based on the observations that he made when he visited the island of St. Vincent in the Spring of 1907, also mentions the hard crust on the surface of the deep ash deposit at the foot of Richmond Ridge to which Mr. Sands refers⁷⁶. This hard crust, which was nearly an inch thick, Dr. Anderson characterizes as being almost like concrete pavement. Among his Plates Dr. Anderson has included a photograph (Plate 21) which shows the vegetation which had taken place in the water-channels of this hard crust in 1907, five years after the eruption⁷⁷. The photograph in Plate 19 shows vegetation which had taken place in ash, the surface of which had not consolidated into a hard crust⁷⁸. The castor oil plant (*Ricinus Communis*) is growing in abundance in ash that is nearly six feet deep. *Indigofera Anil* and *Cassia* sp. are growing densely in ash several feet deep.

(To be concluded)

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⁷³Sands, West Indian Bulletin 12 (1912), 24 (see note 68, above).
⁷⁴*Ibidem*, 24. ⁷⁵*Ibidem*, 31.

⁷⁶Tempest Anderson, Report on the Eruptions of the Soufrière in St. Vincent in 1902, and on a Visit to Montagne Pelée in Martinique, Part II, Philosophical Transactions of the Royal Society of London, Series A, Volume 208 (1908), 275-303, especially 286, and Plates IX-XXV.

⁷⁷A description of the vegetation shown in this photograph is given by Anderson, 286 (see note 76, above).

⁷⁸A description of the vegetation shown in this photograph is given by Anderson, 286.